



Stabilisation of an Endotracheal Tube for the Adult Intensive Care Patient

NSWHealth Statewide Guidelines for Intensive Care

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Disclaimer	<p>This clinical practice guideline (CPG) is aimed at providing the clinicians of NSW intensive care units (ICU) with recommendations to frame the development of policies and procedures related to <i>Stabilisation of an endotracheal tube for the adult intensive care patient</i></p> <p>This CPG is a distillation of several processes: an integrative review of the literature (available up to December 2006); an evaluation of how this literature applies to the NSW intensive care context; the extensive clinical knowledge of the guideline development network members (GDN); and a consensus development process.</p> <p>The CPG is not intended to replace the critical evaluation processes that underpin the development of local policy and procedure nor a clinician's judgment in an individual case.</p> <p>Users of this CPG must critically evaluate this CPG as it relates to local circumstances and any changes in the literature that may have occurred since the dates of the literature review. In addition NSWHealth clinicians must review NSW state government policy documents to identify any directives that may relate to this clinical practice.</p> <p>These guidelines will be updated every 3 years.</p> <p>These guidelines are intended for use in adults only.</p> <p>NSW Health holds copyright of this CPG. No permission is given to redistribute, publish or commercialise this material in any way. The user agrees that in the event that part of the material in this CPG is reproduced or quoted, either in whole or in part, that the copyright owners name and interest in the matter will be acknowledged.</p> <p>Permission MUST be granted to publish this CPG as a stand-alone document on a website other than those of NSWHealth. This permission may be obtained by contacting NSW Intensive Care Coordination and Monitoring Unit (ICCMU). Telephone: + 61 2 4734 1585, Fax: + 61 2 4734 1586, Email: iccmu@wahs.nsw.gov.au M</p>	

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Abbreviations and Acronyms

CI	Confidence interval
CNC	Clinical Nurse Consultant
CNE	Clinical Nurse Specialist
CPG	Clinical Practice Guideline
ETT	Endotracheal tube
EVP	External Validation Panel
GDN	Guideline Development Network
HDU	High Dependency Unit
ICC	Intensive Care Collaborative
ICC-CDC	Intensive Care Collaborative – Consensus Development Conference
ICCMU	NSW Intensive Care Coordination and Monitoring Unit
ICU	Intensive Care Unit
OR	Odds Ratio
PICO	Population Intervention Comparison Outcome
SR	Systematic Review
UEX	Unexpected extubation

Executive Summary

Invasive ventilation is common practice in Intensive Care (IC) for patients with serious breathing difficulties. This is achieved through the insertion of an endotracheal tube (ETT) into the trachea via the mouth or nose and attaching this tube to a ventilator. Ensuring the position of the ETT remains stable, within the patient's airway, is a high clinical priority as tube migration, endobronchial intubation and unexpected extubation (UEX) have potentially life threatening sequelae. Additionally ETT movement may damage a patient's airway and is a source of significant discomfort for the invasively ventilated patient.

The purpose of this clinical practice guideline (CPG) is to provide intensive care clinicians with recommendations to guide clinical practice and the development of local policy. A literature review was undertaken using the PICO (Population Intervention Comparison Outcome) model which identified a systematic review (SR) (Gardner et al 2005). The SR exposed the lack of literature regarding ETT stabilisation practices therefore the recommendations are focused on the principles of ETT stabilisation not specific methods per se. The recommendations contained in this CPG have been framed by: 1) available literature including Gardner SR; 2) a survey of current clinical practices (Appendix 2); and 3) experience of guideline development network members (GDN). The recommendations were developed during a facilitated meeting at the Intensive Care Collaborative Consensus Development Conference (ICC-CDC) held on December 1 2006. Following this group consensus was achieved using an emailed consensus form (for results see Appendix 3). External validation of the guideline was achieved using a Delphi panel, conducted in May 2007, using an emailed voting form with the same level of consensus as the GDN. Although these recommendations have been developed and validated in a systematic way they are not underpinned by a strong body of evidence and as such the guideline user must apply due diligence in the application of the recommendations to their own clinical setting. It is strongly recommended that the guideline user check the literature for studies published since January 2007 that may impact on the clinical practice of ETT stabilisation.

Consensus Opinion	<p>Where no evidence could be applied consensus opinion developed by:</p> <ol style="list-style-type: none"> 1. Formulation of recommendation through discussion 2. Assignment of agreement by individual participants (Likert 1-9) 3. Consensus set at median of 7
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Table 1: Recommendations for Practice		
Number	Statement	Grade of recommendation
1a	Two clinicians must always be present to change the method of securing the endotracheal tube. One clinician changes the tapes while the other holds the ETT in position.	Consensus Opinion
1b	Of the two clinicians changing the ETT securement at least one clinician must be an experienced member of the critical care team.	Consensus Opinion
1c	The method of stabilisation should be consistent within units to promote staff proficiency in safe and effective ET stabilisation.	Consensus Opinion
2	The methods for securing an ETT can be divided into 3 groups: twill tape; adhesive tape and manufactured devices. There is minimal research evidence to support the use of any one method over the other two. However, there are principles that can inform this decision.	Consensus Opinion
2a	The use of adhesive tape/devices should be avoided in patients with impaired facial skin integrity (for example burns, cellulitis).	Consensus Opinion
2b	The use of adhesive tape/devices should be avoided in patients with extreme diaphoresis.	Consensus Opinion
2c	The use of adhesive tape/devices should be avoided in male patients with beards.	Consensus Opinion
3	Endotracheal tube securing methods that may cause venous occlusion should be avoided for patients at risk of raised intracranial pressure	Consensus Opinion
4	There is minimal research evidence to support the frequency of renewal of ETT stabilisation methods. However there are principles that support the decision about frequency.	Consensus Opinion
4a	The ETT securing method should be renewed if the tapes are soiled.	Consensus Opinion
4b	The ETT securing method should be renewed if the ETT is able to migrate/move more than 1 cm.	Consensus Opinion
4c	When using cotton tape the ETT securing method should be renewed if a clinician is unable to insert two fingers between tape and skin.	Consensus Opinion
4d	The ETT securing method should be renewed if the ETT position on CXR is incorrect (tip should be 2.5cm above the carina).	Consensus Opinion
4e	The ETT securing method should be renewed if the method of tube stabilisation is not consistent with Unit practice.	Consensus Opinion
4f	In the absence of other indications the tube stabilisation method should be renewed at least once every 24 hrs to enable skin and mucosal assessment and to prevent sustained pressure on a single point.	Consensus Opinion
5	Assessment of the face should include the condition of the skin of the face, ears and back of neck. In addition the assessment of the oral cavity should be inline with the assessment completed for adequate oral hygiene and includes the mouth, teeth, gums, tongue, mucous membranes, lips and barriers to mouth care.	Consensus Opinion
6	The ventilator tubing should be supported by a ventilator arm that keeps the patient's head in the midline and prevents pressure on the lips.	Consensus Opinion

Clinical Practice Guideline

1. Introduction

Invasive ventilation is common practice in an intensive care unit (ICU) for patients with serious breathing difficulties. Ventilation is achieved through the insertion of an ETT into the trachea via the mouth or nose and attaching this tube to a ventilator. It is vitally important that the position of the ETT remain stable for several reasons:

1. as this tube is fulfilling the function of a patient's airway, the unexpected removal of the tube (unplanned extubation UEX) poses a significant risk to the patient's survival;
2. the tube needs to be stable to ensure optimal ventilation and constant supply of oxygen; and
3. ETT movement within the trachea may cause local trauma and is a significant source of discomfort for the patient.

There are also several clinical concerns to address with respect to patient safety when attempting to achieve a stable ETT. These include:

1. Preventing migration of the ETT and unplanned extubation;
2. Maintaining alignment of the ETT within trachea;
3. Skin integrity of the face and neck; and
4. Maintenance of adequate levels of venous return from the head through the jugular veins.

There are three main methods of achieving tube stabilisation: 1) tying the ETT to the patient's head using white cotton tape; 2) taping the ETT to the patient's face using medical adhesive tape; or 3) using a commercial tube holder. There is a lack of research into the most effective form of ETT stabilisation with a recent systematic review being unable to identify a superior method (Gardner, Hughes et al. 2005). A recent survey of NSW ICUs and High Dependency Units (HDUs) with the capacity to provide short term ventilation was conducted to determine local ETT management practices [see Appendix 2]. Participants from 41 of the 44 eligible units responded (response rate 93%). The white cotton tape method was the most frequently reported method for stabilising the position of an ETT (78%, n=32) however nine units reported using this method in conjunction with a commercial product and a further seven units reported using this method in conjunction with medical adhesive tape. Renewing or changing the ETT tapes is a procedure completed frequently by critical care nurses, however, only 41% (n=17) of NSW ICUs/HDUs had a

written guideline for this procedure and only nine of these protocols were less than two years old.

The recommendations in this guideline were informed by an integrative literature review covering the publication years of 1980-2006 [See Integrative literature review] and the clinical experience of the guideline development network members who were senior clinicians from NSW ICUs. Due to the lack of any evidence these recommendations were considered to be the key guiding principles that a protocol writer should incorporate into whatever method/s of ETT stabilisation are most appropriate for their patient mix and clinical setting.

2. Scope

The recommendations in this guideline are focussed on the clinical practices used to maintain the optimal position of an endotracheal tube that is inserted into an adult in an intensive care unit referred to as 'stabilisation of an endotracheal tube'. The following issues, although considered important, are beyond the scope of this guideline:

- Issues related to patient autonomy such as patient consent and explanation of procedure.
- Documentation of patient assessment and outcomes of nursing procedures.

3. Purpose

This guideline has been developed to provide intensive care clinicians with recommendations or principles to guide the development of local policy/procedure related to stabilisation of an endotracheal tube. The guideline does not address the minutiae of this practice.

4. Target Clinicians

The target clinicians are registered nurses and medical officers working in NSW ICUs. This includes both beginner and experienced clinicians and assumes knowledge of: anatomy and physiology of the head and neck; the purpose of an ETT and importance of maintenance of correct position; possible sequelae associated with the different stabilisation methods; and the consequences of unplanned extubation.

5. How the guideline was developed

This guideline was developed by the ETT guideline development network (GDN) comprised of six senior nursing clinicians and three nursing academics, within the ICCMU Intensive Care Collaborative project. The recommendations were developed during round table discussions at ICC-CDC held on December 1 2006. Consensus was achieved by a postal round whereby a consensus form was sent to GDN members who assigned their level of agreement with

each recommendation statement using a likert scale of 1-9. Consensus was set as a median of at least 7 and the results are set out in Appendix B. This process is described in greater detail under 'Process of guideline development'. Additionally external validation of the guideline was completed using a Delphi panel (see pages 20-21).

6. How to use guideline

The recommendations in this guideline should be used to inform local policy covering care of the ventilated patient including intubation and stabilisation of an ETT.

7. Format of guideline

The Guideline is presented in three main sections:

- Section 1 contains the recommendation statements and supporting narrative;
- Section 2 is a detailed explanation of the Guideline development process;
- Section 3 contains the integrative literature review.

8. Level of Evidence taxonomy

The NHMRC taxonomy (NHMRC 2005) was chosen by the Academic facilitators panel as the most appropriate framework to grade the levels of evidence and recommendations, on the basis of its useability and application to the Australian health care context. Where evidence was limited or not available the GDN members discussed the issue and developed a recommendation statement using their own clinical experience. Consensus was achieved by using the likert scale with a median of at least 7 set as agreement.

9. Infection Control

Prevention of infection is an important aspect of any clinical practice and guideline users are directed to NSWHealth Policy directive (PD2007_036) and local policy to comprehensively identify the infection control elements of this clinical practice. These elements include but are not limited to: use of personal protective equipment, good hand hygiene, correct disposal of equipment and medical waste and isolation of infectious patients.

When renewing ETT tapes both the operator and assistant are at high risk for contact with potentially contaminated patient secretions therefore personal protective equipment including goggles, gloves and masks must be worn.

10. Occupational Health and Safety

Guideline users are directed to local policy and procedures related to occupational health and safety to ensure operator safety whilst completing this procedure.

Recommendations for Practice

The purpose of the recommendations listed here is to inform the development of local policy regarding the stabilisation of an endotracheal tube (ETT). The paucity of research literature regarding this topic has limited the ETT guideline development network's (ETT-GDN) ability to formulate specific recommendations regarding the optimal method of stabilisation and related issues. Therefore these recommendations are considered to be the key principles that should be addressed when a clinician is developing local policy.

The decision to change or renew a patient's ETT stabilisation method is influenced by several factors however must be made on the basis of ensuring the ETT remains in the optimal position. These factors may include:

- a. Is the patient's ETT in the optimal position and will it remain there?
If the ETT is in imminent danger of UEX or endobronchial intubation the clinician should prioritise correcting this.
- b. What is the patient's current clinical status?
Since the risk of UEX is heightened during the procedure if a patient's clinical status is critical and unstable changing the ETT stabilisation method may not be warranted unless the ETT position is unstable.
- c. What is the patient's level of consciousness?
A patient who is restless, agitated or has an inadequate level of sedation is more likely to self-extubate (Boulain 1998) and this risk will be increased when the stabilisation method is being renewed.
- d. What is the impact of the ETT stabilisation method on the patient's venous return from the head and facial and neck skin and oral cavity?
- e. Has the method of ETT stabilisation been renewed within the past 24 hours?
- f. Is the method of ETT stabilisation consistent with unit guidelines?

The recommendations for practice have been grouped under the following headings

1. Clinical Governance
2. Choice of Method
3. Patients with risk of raised intracranial pressure
4. When to change ETT Stabilisation method
5. Assessment
6. General

Number	Statement: Clinician Governance	Grade of recommendation
1a	Two clinicians must always be present to change the method of securing the endotracheal tube. One clinician changes the tapes while the other holds the ETT in position.	Consensus Opinion
1b	Of the two clinicians changing the ETT securement at least one clinician must be an experienced member of the critical care team.	Consensus Opinion
1c	The method of stabilisation should be consistent within units to promote staff proficiency in safe and effective ET stabilisation.	Consensus Opinion

The potential for unexpected extubation (UEX) is increased during the period of time when a patient's ETT tapes are being changed. UEX represents a significant risk for the ventilated with international rates reported ranging from <1% to 22.5%(Happ 2002; Yeh, Lee et al. 2004) however Australian rates are generally low with reports of 2.6% (Birkett, Southerland et al. 2005). There is paucity of information about related adverse patient outcomes. The 2006 survey of tracheal tube stabilisation practices [Appendix 2] established that in all NSW ICUs it was an accepted standard that two staff members complete this procedure. Clinicians agreed that one role was based around changing of the tapes, assessment of the skin and oral cavity and ensuring the tube is in the optimal position. The other clinician holds the ETT in position until stabilisation method has been renewed and ETT position stable. In addition to there being two staff members it is important that one of these be an experienced intensive care clinician familiar with both the procedure and potential complications. The experienced clinician will be able to both identify and intervene early when problems occur, and will be able to instruct the junior colleague regarding the procedure.

Consistency of ETT stabilisation practice will help develop a novice's skills and may assist in preventing UEX therefore the method of ETT stabilisation should be limited to a minimum number of accepted methods.

The external validation panel (EVP) supported all of these recommendations.

Number	Statement: Choice of Method	Grade of recommendation
2	The methods for stabilising an ETT can be divided into 3 groups: twill tape; adhesive tape and manufactured devices. There is minimal research evidence to support the use of any one method over the other two. However, there are principles that can inform the choice of method for specific clinical situations	Consensus Opinion
2a	The use of adhesive tape/devices should be avoided in patients with impaired facial skin integrity (eg burns, cellulitis).	Consensus Opinion
2b	The use of adhesive tape/devices should be avoided in patients with extreme diaphoresis.	Consensus Opinion
2c	The use of adhesive tape/devices should be avoided in patients in male patients with beards.	Consensus Opinion

There are three main methods of achieving tube stabilisation: 1) tying the tube to the patient's head using white cotton tape; 2) taping it to the patient's face using medical adhesive tape; or 3) using a commercial tube holder. Gardner et al (2006) conducted a systematic review to establish what method of ETT stabilisation: 1) resulted in the least amount of tube displacement; 2) resulted in the least amount of unplanned or accidental extubations; 3) resulted in the least amount of facial skin, lip and/or oral mucosa breakdown; and 4) is preferred by nurses for the maintenance of oral hygiene. This review was hampered by the heterogeneity of design and quality of the seven studies included. In addition studies were dated and some of the commercial products not available in Australia. No evidence was found regarding outcomes related to tube displacement. One study (Tominaga, Rudzwick et al. 1995) found that medical adhesive tape significantly reduced the UEX rate over four study periods (15% during control, 4%, 2% and 6% in following periods). However non-equivalent study periods and treatment of patients especially with respect to sedation and pain relief as well as the probability of a significant Hawthorne effect limit the clinical application of these findings. By contrast a multicentre prospective observational study of UEX rates in French ICUs identified 46 UEX episodes in 426 patients over a two-month period (UEX rate = 10.8%). In this study endotracheal fixation with only thin adhesive tape, orotracheal intubation and the lack of intravenous sedation were three factors most common to UEX (Boulain 1998). However there was a limited description of

how these variables were defined leading to possible bias especially with respect to what 'thin adhesive tape' actually was. A limited meta-analysis by Gardner et al (2006) indicated that a commercial device might result in less lip excoriation (OR 0.22[0.10, 0.50, 95%CI]) and reduce the incidence of facial trauma (OR 0.40 [0.13, 1.22 95%CI]), however these commercial products are not available in Australia.

The external validation panel (EVP) supported all of these recommendations.

Number	Statement: Patients with risk of raised intracranial pressure	Grade of recommendation
3	Endotracheal tube securing methods that may cause venous occlusion should be avoided for patients at risk of raised intracranial pressure.	Consensus Opinion

Most ETT stabilisation methods require the tapes or ties to go around the upper part of neck. There is however a theoretical risk that doing this may impair the venous drainage from the head with a possible impact on intracranial pressure. The tracheal tube practices survey [Appendix 3] identified five units who varied their practices for neurological or neurosurgical patients for this reason. Whilst no published research data was found to support this, the GDN members feel this is an important consideration for clinicians when choosing the most appropriate method of ETT stabilisation.

The EVP endorsed this recommendation.

Number	Statement: When to change ETT stabilisation method	Grade of recommendation
4	There is minimal research evidence to support the frequency of renewal of ETT stabilisation methods. However there are principles that support the decision about frequency.	Consensus Opinion
4a	The ETT securing method should be renewed if the tapes are soiled.	Consensus Opinion
4b	The ETT securing method should be renewed if the ETT is able to migrate/move more than 1 cm.	Consensus Opinion
4c	When using cotton tape the ETT securing method should be renewed if a clinician is unable to insert two fingers between tape and skin.	Consensus Opinion
4d	The ETT securing method should be renewed if the ETT position on CXR is incorrect (tip should be 2.5cm above the carina).	Consensus Opinion
4e	The ETT securing method should be renewed if the method of tube stabilisation is not consistent with Unit practice.	Consensus Opinion
4f	In the absence of other indications the tube stabilisation method should be renewed at least once every 24 hrs to enable skin and mucosal assessment and to prevent sustained pressure on a single point.	Consensus Opinion

The period during renewal of ETT stabilisation methods is a time of increased risk of UEX therefore the decision to carry out this procedure must be made on the basis of clinical need and when the patient's condition is stable. However despite the centrality of this practice to intensive care nursing there was no research evidence or textbook recommendation identified to frame recommendations concerning when and how frequently to renew the method of ETT stabilisation. Therefore the GDN members developed these recommendations through discussion.

The ETT stabilisation method can become soiled quickly by oral secretions or blood and these have potential impacts on both skin integrity and tape security. For these reasons it was considered important that the tapes be renewed when they become soiled.

The consequences of migration or movement of an ETT within a patient's airway can include patient discomfort and pain, inadequate ventilation and tracheal damage however no reference or research was found indicating a consensus regarding the accepted safe level of ETT movement. ETT movement may be from side to side or 'in and out' of the airway (often referred to as telescoping) and movement in either direction is a significant source of discomfort for the patient and may cause damage to the skin and mucosal lining of the trachea. The recommendation of 1cm maximum movement is based on consultation with intensive care medical specialists and group consensus of GDN members. For this guideline an ETT that moves more than 1cm is considered to be unstable and the method should be renewed as soon as prioritised given other factors such as:

1. The amount of ETT movement;
2. Patient's general condition especially respiratory and cardiovascular status;
3. Patient movement for procedures or transport outside the ICU; and
4. Other life saving procedures.

Assessment of restrictiveness of ETT tapes or devices is open to interpretation. The recommendation to use one or two fingers is included in a number of CPGs sourced from across NSW ICU [see

http://intensivecare.hsnet.nsw.gov.au/five/staffonly/guidelines_type_ventilation.php].

During discussions a number of concerns were raised regarding this particular practice including the subjective nature of this measure, differences in patients' facial skin integrity and the potential for facial swelling. However although the recommendation is made to ensure two fingers can be inserted between skin and cotton tapes this should be applied with caution and other recommendations taken into consideration.

A daily CXR is a common investigation both to identify the development or resolution of pathological lung changes and to check the position of the endotracheal and nasogastric tube. The optimal position of the ETT measured fiberoptically is between 2.5–4 cm above the carina (Evron, Weisenberg et al. 2007). Migrations of the ETT further down the trachea risks injury to the carina and/or endobronchial intubation, a potentially catastrophic complication. Conversely if the ETT is not positioned far enough down the trachea there are several risks including: vocal cord injury as the cuff impacts on the vocal cords; inadequate ventilation; patient agitation due to discomfort; and unexpected extubation. Therefore for most patients the ETT position on CXR should be checked before the ETT stabilisation method is changed to ensure the ETT is in the optimal position. It is also common practice

to mark this position on the ETT (depending on the stabilisation method) and to document this in the patient's notes and/or flowchart.

Limiting the number of methods of ETT stabilisation within an ICU will promote both consistency of practice and skill acquisition of inexperienced clinicians. However whilst the recommendation is made to change the method of ETT stabilisation if this method does not comply with unit guidelines this recommendation should not be the only reason that the ETT stabilisation method be changed. This means that the other recommendations should be taken into account before renewing the ETT stabilisation method.

Within the CPG identified from across NSW there was a consistency in practice regarding the need to change ETT tapes at least daily. However in the case of a commercial product the manufacturer's guidelines should be followed. A daily change of ETT tapes or ties will facilitate an assessment of the impact of the ETT and stabilisation method on the patient's skin and oral or nasal mucosa. Additionally it will allow the ETT to be moved to another position within the oral cavity that may prevent the development of pressure areas within the mouth or on the lips.

The EVP supported all of these recommendations.

Number	Statement: Assessment	Grade of recommendation
5	Assessment of the face should include the condition of the skin of the face, ears and back of neck. In addition the assessment of the oral cavity should include the mouth, teeth, gums, tongue, mucous membranes, lips and barriers to mouth care.	Consensus Opinion

Application of adhesive tapes to the skin or tying cotton tape around a patient's head may damage a patient's facial and neck skin as well as the oral cavity, however only limited research was identified that would indicate the level of risk. The lips, especially at the corners, are particularly vulnerable. A meta-analysis found that a commercial device reduced the risk of lip excoriation (OR 0.2, CI= 0.1-.05) however this commercial device is no longer available in Australia (Gardner et al 2005: 161). The GDN members conclude that shift-by-shift assessment of the skin and oral cavity to identify lesions is necessary to ensure timely intervention and these interventions may include changing the method of ETT stabilisation.

The EVP endorsed this recommendation.

Number	Statement: General	Grade of recommendation
6	The ventilator tubing should be supported by a ventilator arm that keeps the patient's head in the midline and prevents pressure on the lips.	Consensus Opinion

Maintaining tube alignment within the trachea is dependant on two factors: 1) security of stabilisation method; and 2) use of ventilator arms to hold the weight of the ventilator tubing and preventing traction on and movement of the ETT. Study findings identify significant discomfort from tube movement (Johnson and Sexton 1990; Grap, Glass et al. 1995; Pochard, Lanore et al. 1995). The pressure on the lips created by the unsupported weight of ETT and ventilator tubing may compromise the microcirculation of the lips and lead to a pressure area. Therefore, for reasons outlined earlier and to promote patient comfort, use of additional supports, such as ventilator arms, to prevent unnecessary ETT movement are recommended. It should be noted however that the level of the ventilator arm must keep the ventilator tubing in a position that prevents the backwash of any fluid into the patient. The EVP endorsed this recommendation.

Process of Guideline Development

The Endotracheal Tube GDN (ETT-GDN) was established at the 'Getting evidence into practice' workshop held on June 14 2005 [<http://intensivecare.hsnet.nsw.gov.au/five/htm/education.php>]. The senior nurses, who attended, were able to self-select which guideline to develop. In the period between June 2005 and December 2006 GDN meetings were convened via teleconference with ICCMU CNC coordinating the process. At the initial meeting the scope and state of current practice was established and issues related to ETT stabilisation were brainstormed. At subsequent meetings a clinical question and literature review protocol were developed and literature review tasks allocated. The project manager developed a data extraction tool [see Appendix 4] and GDN member training was completed during a scheduled meeting. The project manager collated the article reviews and these compilations were sent to GDN members some weeks prior to the Intensive Care Collaborative Development Conference (ICC-CDC). Prior to ICC-CDC an on-line forum was established to promote discussion of evidence with respect to specific questions arising from the broader PICO question (<http://intensivecare.hsnet.nsw.gov.au/six/blogcms/forum/>).

Midway through 2006 a group of critical care academics from Australia and New Zealand were identified as academic facilitators for each GDN [see page 20]. A number of meetings were held to establish the final processes of guideline development in particular the taxonomy for levels of evidence and recommendations, as well as consensus development [see Box A].

Description of Consensus development process

On Friday December 1 2006 the ICC-CDC was held and all GDNs met to develop the recommendations for practice under the facilitation of an Australasian critical care academic (Anne Gardner). Unfortunately only four members of the ETT GDN were present at this meeting. Each GDN followed the processes outline in Box A. This process was difficult for the ETT GDN as there was a paucity of literature available. Therefore the recommendations contained in this CPG were framed around what the GDN members consider to be the principles guiding the method of ETT stabilisation. These principles were developed through round table discussion and consideration of the key points contained in the modified clinical question.

What method of ETT stabilisation results in?

- a. Less than 1cm of proximal tube displacement;
- b. Least amount of oral mucosal breakdown (less than stage two pressure ulcer);
- c. Least amount of skin breakdown to lip and facial skin and neck integrity; and
- d. Least amount of unplanned and accidental extubations.

Box A: Process of consensus development at ICC-CDC

1. Establish current practice
2. Revisit clinical question
3. Review papers
 - a. Include relevant papers
 - b. Assign level of evidence for each paper
4. Recommendation
 - a. Develop statement
 - b. Assign grade of recommendation
 - i. From literature
 - ii. Expert opinion
5. Assign agreement using Likert Scale
6. Review voting - consensus is a median of 7-9
7. Revisit process once only if consensus not reached

Consensus on these recommendations was not developed at the ICC-CDC as the GDN members thought it was important to develop the recommendations and to ensure all GDN members could participate in the consensus process. Following the ICC-CDC several recommendations were developed to fill a number of identified gaps in the recommendation list. Consensus was then achieved by sending a consensus voting form by email to all GDN members. Consensus was set as a median of 7 using a likert of 1-9. The results of this process are contained in appendix 3.

Guideline construction

Once the recommendations were developed the guideline was constructed in three phases:

1. A draft guideline was written by the primary authors and sent to the other members of the GDN for comment, clarification and additions;
2. The draft guideline was sent to an external validation panel (EVP) for clarification; and
3. The draft guideline was amended to reflect the results of the EVP process and the final guideline sent to the ETT-GDN for comment.

In addition the NSW Clinical Excellence Commission endorsed the process of guideline development.

Academic Facilitators

Convenor, Academic Facilitators	Professor Doug Elliott Director of Research, Faculty of Nursing, Midwifery and Health University of Technology Sydney
Oral Care GDN	Associate Professor Patricia Davidson Professor of Cardiovascular and Chronic Care School of Nursing and Midwifery Curtin University of Technology
Eye Care GDN	Ms Andrea Marshall Sesqui Senior Lecturer in Critical Care Faculty of Nursing and Midwifery The University of Sydney
Suction of an artificial airway GDN	Dr Bridie Kent Director of Clinical Nursing Research School of Nursing - Faculty of Medical and Health Sciences University of Auckland
	Professor Wendy Chaboyer Director, Research Centre for Practice Innovation Griffith University Queensland
Stabilisation of an endotracheal tube GDN	Associate Professor Anne Gardner Professor, School of Nursing, Midwifery and Nutrition, James Cook University
	Professor Sandy Middleton School of Nursing Australian Catholic University, National - North Sydney Campus
Arterial catheter GDN (nursing management)	Dr Tina Jones Manager, Australian Centre for Evidence Based Clinical Practice, Flinders Medical Centre Senior Lecturer, Faculty of Health Sciences, Flinders University
CVC GDN (nursing management)	Dr Judy Currey Senior Lecturer, School of Nursing Deakin University Melbourne

The Academic facilitators were identified through professional networks and were not paid to participate in the ICC project however ICCMU paid the costs of travel and accommodation for the ICC-CDC. Apart from Professor Elliott the other academic facilitators did not join the ICC project until June 2006. Five meetings were held, four by teleconference and one the day prior to the ICC-CDC. Tasks completed during these meetings included:

1. Assignment to a particular GDN
2. Discussion regarding the most appropriate levels of evidence and recommendation taxonomy
3. Format of the consensus conference (ICC-CDC)
4. Process of developing recommendations and reaching consensus
5. Process for writing guidelines and peer reviewed publications.

External Validation Process

In May 2007 external validation of the guideline was conducted using a limited Delphi round. The purpose of validation of a guideline by an external group of experts is threefold. Firstly, this group reviews the purpose and scope of the guideline to ensure the relevant clinical aspects have been addressed. Secondly, the panel reviews the process to ensure rigour of guideline development. Lastly, the panel reviews the clinical practice recommendations for suitability in terms of both the available scientific evidence and current clinical practice. Furthermore a panel should include experienced clinicians and academics (AGREE 2001; Alderson 2006). The process of consensus development within the EVP was formalised using a single Delphi round and a Likert scale (Rycroft-Malone 2001). A Delphi round was used to promote the involvement of clinicians and academics from across Australia thus ensuring consultation with a broad range of intensive care clinical and academic expertise.

Formation of External Validation Panels

Panel members (n=46) for all guidelines were identified using professional networks and associations and were allocated to a specific guideline using two processes. Firstly there were nine panel members who were approached directly because of their acknowledged expertise with a particular practice (including research or professional role). The other panel members were randomly allocated to a specific guideline by placing all names into a hat and assigning names sequentially to each guideline until names and panel positions were exhausted. Panel members completed a conflict of interest form which included demographic data. Table 3 lists panel members. One nursing academic was a member of two panels.

Method of validation

Panel members received the draft guideline and the literature review (which included the data extraction tools completed by the GDN members) along with a recommendation agreement form. They were then asked to assign their level of agreement (Likert 1-9) with the recommendation statement. A median score of at least 7 was set for consensus to be reached. Table 5 sets out the results of the EVP process for this guideline.

Table 2: ETT Stabilisation External Validation Panel Members	
EVP Role	Name qualifications and position
Nursing Academic	Dr Fiona Coyer RN RM ENB100 (ICUCert), PGCEA PhD Senior Lecturer Queensland University of Technology
Clinical Nurse	Debe Herewane RN, CCC, Grad Dip Intensive Care Nursing, Grad Cert Retrieval Nursing, MNSc Clinical Unit Manager ICU Royal Adelaide Hospital (SA)
Clinical Nurse	Janet Masters RN CCC BHSc(Nur) MN Acting Infection Control CNC Blacktown Mt Druitt (SWAHS – NSW)
Clinical Nurse	Elizabeth Moore CNS RN, Grad Dip Adult Crit Care (completing MPH)
Clinical Nurse	Leonie Weisbrodt RN BN Grad Cert IC (MNHons final year) Research Coordinator ICU Nepean Hospital (SWAHS – NSW)
Medical Specialist	Dr Rahul Panit MD DA FJICM Senior Registrar Fellow, ICU Nepean Hospital (SWAHS – NSW)
Medical Specialist	Dr Paul Phipps Director ICU Manly Hospital (NSCCAHS – NSW)

Table 3: EVP results					
Recommendation Number	25 th	Median	75 th	Range	
				Minimum	Maximum
1a	9	9	9	8	9
1b	8.5	9	9	8	9
1c	7	8	9	7	9
2	8.5	9	9	7	9
2a	8.5	9	9	8	9
2b	7.5	8	9	7	9
2c	8	8	9	6	9
3	8.5	9	9	8	9
4	8	9	9	7	9
4a	7	8	8.5	6	9
4b	8	8	9	7	9
4c	7	8	8.5	7	9
4d	7.5	9	9	6	9
4e	7	7	9	3	9
4f	7.5	8	9	7	9
5	8	8.5	9	6	9
6	7.25	8.5	9	7	9

Integrative Literature Review

Introduction

A thorough review of the literature is an integral part of developing evidence based practise guidelines. The literature search strategy for this guideline was developed within teleconferences attended by the Guideline development network (GDN) members. However whilst this search was in progress a systematic review was published (Gardner, Hughes et al. 2005). The GDN search identified only 2 further descriptive studies that were relevant.

1. Literature Search Protocol

Structured Research Question:			
For the adult intensive care patient what method of securing an endotracheal tube / tracheal tube provides optimal stabilisation, maintains skin, oral cavity and trachea integrity and is most comfortable for the patient?			
P	Population (of interest)	Intubated intensive care patients (+ burns/Neuro/Faciomaxillary)	
I	Intervention	Stabilisation of tracheal tube	
C	Control (group)		N/A
O	Outcome (measured)	Migration of tube, skin integrity, unexpected extubations, integrity of oral cavity, patient comfort, cuff pressure	
Search Strategy			
Databases:		CINAHL, MEDLINE, PBMED and Cochrane Library for	
Key words:		Endotracheal tube or tracheostomy tube, unplanned extubation AND Intensive care or critical care, cuff pressure	
Publication years:		1990 – March 2006.	
Other search filters:			
English language only		yes	
Adult		yes	

2. Literature Review Process

A single reviewer using the tools in Appendix 1 reviewed articles.

3. Literature Synthesis Process

The reviews plus all articles were sent to all members of the GDN for review prior to the ICC-CDC.

4. Taxonomy for level of evidence and grade of recommendation

Level	Intervention	Numbers of Studies found
I	A systematic review of level II studies	1
II	A randomised controlled trial	
III-1	A pseudorandomised controlled trial (i.e. alternate allocation or some other method)	
III-2	A comparative study with concurrent controls: <ul style="list-style-type: none"> • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group 	
III-3	A comparative study without concurrent controls: <ul style="list-style-type: none"> • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group 	
IV	Case series with either post-test or pre-test/post-test outcomes	2

Component	A	B	C	D
	Excellent	Good	Satisfactory	Poor
Volume of evidence	several level I or II studies with low risk of bias	one or two level II studies with low risk of bias or a SR/multiple level III studies with low risk of bias	level III studies with low risk of bias, or level I or II studies with moderate risk of bias	level IV studies, or level I to III studies with high risk of bias
Consistency	all studies consistent	most studies consistent and inconsistency may be explained	some inconsistency reflecting genuine uncertainty around clinical question	evidence is inconsistent
Clinical impact	very large	substantial	moderate	slight or restricted
Generalisability	population/s studied in body of evidence are the same as the target population for the guideline	population/s studied in the body of evidence are similar to the target population for the guideline	population/s studied in body of evidence different to target population for guideline but it is clinically sensible to apply this evidence to target population	population/s studied in body of evidence different to target population and hard to judge whether it is sensible to generalise to target population
Applicability	directly applicable to Australian healthcare context	applicable to Australian healthcare context with few caveats	probably applicable to Australian healthcare context with some caveats	not applicable to Australian healthcare context

5. Summary Tables of Research Papers included

Short reference	Design/Method	Sample Description	Outcomes/findings	Methodological Quality
Boulain T (1998). Unplanned Extubations in Adult Intensive Care Unit. Am J of Critical Care Medicine 157: 1131-1137.	Prospective observational multicenter study 2 months Data collection (see inf. Below) Patient demographics Daily monitoring UEX questionnaire	426 Female/Male 262/164 Age 57 ± 19 (12-44) SAPS 13.9 ± 5.3 (1-34) Medical patient – 786/426	UEX 46 pt with 57 events (10.8%) Reintubation (p<0.0001) UEX# 28/46 Non UEX 28/284 #19/28 within 2 hours Mortality 1 death a prolonged cardiac arrest caused by UEX in 41yroid Risk Factor Adjusted OR ^{MH} (95%CI) Lack of IV sedation 5.9 (3.5 – 9.9) orotracheal intubation 3.7 (2.7 – 5) Lack of strong tube fixation 3.45 (2.2 – 5.2) • No differences between groups for rate of laryngeal oedema • Additional LOV post reintubation • Nurse patient ratio • No bleeding complications	<ul style="list-style-type: none"> • Daily monitoring by busy physician for event → missed patients • Variables well described except “lack of strong tube fixation”.
Level of Evidence: IV				
Grap, Glass & Lindamood (1995) Factors related to unplanned extubation of endotracheal tubes. Critical Care Nurse, 4: 57-65	Retrospective review of patient charts where an incident form was completed when an episode of UEX occurred. Interview of patients, who had experienced a UEX, using a questionnaire with 10 closed questions	122 episodes for 8820 admissions No demographic data supplied 46 patients were interviewed	<ul style="list-style-type: none"> • No standard method of taping • 99 (81%) adequate taping • 93 (76%) Oral tube • 63 (51%) Supine with HOB • 56 (46%) reintubated • 9 (7.4%) complications • Patient recollections n=46 • 31 (76.4%) remember the ETT • 24 (52.2%) remember pulling ETT out • 27 (58.7%) complained of discomfort & pain • 12 (26.1%) reintubated • Wide range of incidence of UEX from 9% to 1.6%. This was inversely related to the % of intubated patients cared for in the respective units 	<ul style="list-style-type: none"> • UEX incidents are self reporting → accuracy of incident occurrence • Limited reporting on confounding variables such as sedation, nurse patient ratios, restraints and LOC • Retrospective design • Inter rater reliability • No description of what constituted adequacy of ETT stabilisation • No comparative data on similar patient cohort to compare outcomes • Clinical significance of event is not explored well.
Level of Evidence: IV				

Short reference	Clinical question/search strategy	Article review method	Outcomes/findings	Methodological Quality
Gardner A, Hughes D, Cook R, Osborne S and Gardner G (2005) Best practice in stabilisation of oral endotracheal tubes: A systematic review, Australian Critical Care. 18(4) 158-165	Which method of ETT stabilisation <ol style="list-style-type: none"> 1. Results in the least amount of tube displacement; 2. Least amount of unplanned or accidental extubation; 3. Least amount of facial skin, lip/ or oral mucosa breakdown; 4. Is preferred by nurses for the maintenance of oral hygiene. <p>Databases: all relevant Key words: all relevant</p>	<ul style="list-style-type: none"> • Titles and abstracts examined for relevance by all of review group independently • Full papers retrieved when all in agreement AND if there was dispute • Each paper reviewed by two reviewers using a standardised tool • Data extracted for possible metanalysis 	<ol style="list-style-type: none"> 1. Papers were of generally poor quality with many variations in outcomes, methodology and quality of writing, changes in protocol 2. No papers adequately controlled for confounders 3. Use of a commercial product reduced the incidence of lip excoriation (OR 0.2 [CI= 0.1-.05] $p < 0.001$); 4. Use of a commercial product reduced the incidence of facial trauma (OR 0.4 [CI= 0.1-1.12] not significant) 5. ETT displacement was 0.6cm less (CI=0.4-0.9, $z=4.07$, $p < 0.001$) if a commercial product was used however tests for heterogeneity tests suggests this may not be the result of chance; 6. unable to conclusively identify which method of ETT stabilisation results in the outcomes identified 	<ul style="list-style-type: none"> • Review hampered by lack of papers • Patient experience not included

6. Summary Table of Research Papers not included

Full name of paper	Reasons for non inclusion
Ganner (1991) The accurate measurement of endotracheal tube cuff pressures. British Journal of Nursing 10 (17) 1127-1134.	Cuff pressure not within scope of guideline
Lovett, PB, Flaxman A, Sturmman KM and Bijur P (2006) The insecure airway: a comparison of knots and commercial devices for securing entotracheal tubes. BMC Emergency Medicine, 6(7): http://biomedcentral.com/1471-227X/6/7 accessed February 10 2007	Bench test of devices not readily available in Australia Limited reporting of results Not tested on humans.
Stewart S.L. et al (2003) A comparison of endotracheal tube cuff pressures during estimation techniques and direct intracuff measurement. AANA Journal, 71 (6) 443-447.	Cuff pressure not within scope of guideline

Appendix 1: Data Extraction Tools

Primary Study	The empty cells are for describing or discussing the concept above. If RCT use validity Checklist at bottom of page - Cells will expand / use small font			Use article in systematic review narrative Yes /No		
Full reference Ethics approval sort/gained Yes/No						
Study Aims/Objectives	Setting	Sample Inclusion/exclusion criteria	Interventions	Outcome Measure/s		
Short reference	Design/Method	Sample Description	Outcomes/findings	Methodological Quality		
Is the literature review adequate? Yes/No	Does the method suit the question/s? Yes/No	Sample size calculated and then achieved? Yes/No	Statistical significance? Yes/No	What are the authors conclusions ?		
Are data collection instruments adequately described? Yes/No	RCT or quasi-experimental? Yes/No (RCT score)	Is the sample homogenous? Yes/No	Clinical significance? Yes/No	Clinical Bottom Line		
Were data collection instruments validated? Yes/No	Were the statistics used appropriate? Yes/No	Were all patients enrolled accounted for? Yes/No	Is there enough information to judge results? Yes/No			
Randomised Control Trial Validity Checklist #		Yes	No	?		
Was the assignment to treatment groups really random?					Were the control and treatment groups comparable at entry?	
Were the participants blinded to treatment allocation?					Were groups treated identically other than for the named interventions?	
Was allocation to treatment groups concealed from allocator?					Were the outcomes of people who withdrew described and include in the analysis (ie was the analysis by intention to treat?)	
Were those assessing outcomes blind to the treatment allocation?					Were outcomes measured in a reliable way?	
					Was an appropriate statistically analysis used?	

Reviews – systematic and narrative

- Use one per article which is a review of the literature.
- Please be brief. Cell size is locked so add text; use a smaller font size to fit your conclusions in.
- Where yes/no is asked for, text can be added to flesh out answer.
- Where a number exists, please refer to the expanded question.
- For the databases searched please add a tick and describe the hand search strategy.

1. Is there an explicit review plan documented?
2. Was an explicit search strategy documented?
3. Was an explicit article review method used?
4. Were points 1-3 covered adequately?
5. Does the summary of each reviewed study reflect the essential components of the study design, research process and analysis techniques?
6. Is the organisation of the reviewed studies chronological and logical?
7. Does the organisation of the reviewed studies lead the reader to the same conclusions as the authors?

Full Reference ⇨			
1 - Review Plan - yes/no		3 - Review Method - yes/no	
Clinical Question -		What was the article review method?	
→ Population -		Are all the relevant concepts and variables included? yes/no	
→ Intervention/s		5 - Summary yes/no	
→ Outcome/s		7- Organisation ⇨ Conclusions? yes/no	
2 - Search Strategy		4 Quality of the review –	
Keyword/s (list)		Limits (list)	
Search Time Line		Are the conclusions of the authors warranted? Yes/no & discuss	
Data Bases – adequate? Y/N		Please tick list below <input checked="" type="checkbox"/>	
CINAHL	Pubmed	Embase	Cochrane
Psych info	DARE	Hand search	Other

Appendix 2: Survey of current NSW ETT and tracheostomy clinical practices

- This survey highlights a number of issues in relation to the practice of tracheal tube stabilisation across NSW.
- Protocols covering this important clinical practice are deficient in number:
 - Protocols for both ETT and Trache - 30% (n=12)
 - Protocol for ETT only - 12.5% (n=5),
 - Protocol for Trache only - 30% (n=12)
 - Neither protocol - 27.5% (n=11)
- The higher levels of units (both JFICM and NSW Health) were more likely to have a protocol than the lower levels. However this was only statistically significant when units were grouped into HDU + Level 1 JFICM and Levels 2+3 JFICM (χ^2 p=0.0474)
- The presence of an educator did not
- Where protocols existed only 52% of ETT (n=9) and 60% of tracheostomy (n=15) protocols were less than two years old.
- The most common method of stabilisation for an ETT is cotton or twill tape (n=32, 78%).
- The most common method of stabilisation for a tracheostomy tube is the Velcro tape from Portex (n=24, 62%).
- 10/17 units with ETT protocols and 14/25 units with tracheal tube protocols described the protocols as being based on evidence from the literature.
- Variation from either protocol or normal accepted practice included length of ventilation, patient diagnosis, and other patient factors.
- Whilst the majority of those interviewed were satisfied with the practice in their unit 36 % -ETT and 19% -trache were neutral or not satisfied. This might be reflected by 11/41 answering that: 1) skin breakdown occurred either frequently or variable; and 2) 13/41 extubation was related to the method of tube.

Summary Table		Endotracheal Stabilisation Methods	Tracheostomy Stabilisation Methods	Additional
Protocol	Existence	17/41 (41%)	25/41 (61%)	Level 1+ HDU less likely to have a trache protocol (chi test p=0.02)
	Age of protocol	Both protocols 30% (n=12), Only trache 30%(n12), only ETT 12.5% (5), neither 27.5% (11).		
		< 2yrs - 9/17 > 2yrs - 7/17	< 2yrs - 15/25 > 2yrs - 10/25	
Dominant method		32/41 Cotton or twill tape 5/41 Adhesive tape 3/41 Commercial (E-tad)	24/39 Velcro (Portex) 15/39 cotton tape	
Who decides which method of tracheal tube stabilisation is used?		Nursing staff	Nursing staff	
Variation	N=	23/41	15/41	
	Reason	Length of ventilation Diagnosis (neuro n=5) Patient factors	New tracheostomy use cotton tape then change to velcro	
Are you personally satisfied with this area of clinical practice in your unit?		26/41 satisfied/very satisfied	33/41 satisfied/very satisfied	
Audit		2/41 retrospective audits in last 12 months	1/41 prospective audit 2-4 yrs	
Are endotracheal tubes routinely shortened in your unit?		9/41 Improve airway stability Decrease dead space ventilation Anaesthetist preference	NA	
How many staff are required to renew the stabilisation method?		41/41 2 people	40/41 2 people 1/41 3 people	
Awareness of ACC Systematic Review		20/41 Level 2+3 17/29 (JFICM) were more likely to be aware than HDU + level 1 (JFICM) (3/12) chi test p=0.00		
Extubation		8/41 method of stabilisation was associated with extubation plus 5 were unsure		
Skin	Assessment	34/41 part of protocol		
	Breakdown	29/41 rarely/very rarely, 10/41 variable, 1/41 quite frequently		

Appendix 3: Consensus Results for ETT-GDN

Recommendation Number	Scores of GDN members								quartile	median	quartile	Range	
	1	2	3	4	5	6	7		1	2	3	Minimum	Maximum
	1	2	3	4	5	6	7		1	2	3	Minimum	Maximum
1a	9	9	9	9	9	9	9		9	9	9	9	9
1b	9	9	9	9	9	8	8		9	9	9	8	9
1c	9	9	9	9	8	7	9		9	9	9	7	9
2	9	9	9	8	9	8	9		9	9	9	8	9
2a	9	9	9	9	9	8	9		9	9	9	8	9
2b	9	9	9	9	8	8	9		9	9	9	8	9
2c	9	9	8	9	8	7	9		8.5	8.5	8.5	7	9
3	9	9	9	8	8	8	9		8.5	8.5	8.5	8	9
4	9	9	9	8	9	7	9		9	9	9	7	9
4a	9	9	8	8	8	6	9		8	8	8	6	9
4b	9	9	9	9	6	8	9		9	9	9	6	9
4c	9	9	7	9	7	6	9		8	8	8	6	9
4d	9	9	9	9	8	4	9		9	9	9	4	9
4e	9	9	8	7	7	6	9		7.5	7.5	7.5	6	9
4f	9	7	9	9	9	7	9		9	9	9	7	9
5	9	9	8	8	9	8	9		8.5	8.5	8.5	8	9
6	9	9	7	8	7	8	9		8	8	8	7	9

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